Reg. No. : | | | | | | | | | | |

Question Paper Code: 41457

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2016

Fourth Semester

Electronics and Communication Engineering

14UEI422 - LINEAR CONTROL ENGINEERING

(Regulation 2014)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. In force-voltage analogy, velocity is analogous to

   (a) Current (b) Charge (c) Inductance (d) Capacitance

2. _____ is a closed loop system

   (a) Auto pilot for an aircraft system (b) Direct current generator
   (c) Car Starter (d) Electric switch

3. From which of the following, transfer function can be obtained?

   (a) Signal flow graph (b) Analogous table
   (c) Input-Output ratio (d) Standard block system

4. Velocity error constant of the system is measured when the input to the system is _____ function

   (a) Parabolic (b) Ramp (c) Impulse (d) Step

5. Phase margin of the system is used to specify which of the following?

   (a) Frequency response (b) Absolute stability
   (c) Relative stability (d) Time response

6. The frequency at which the phase of the open loop transfer function is _____

(a) 0° (b) 180° (c) 360° (d) 60°

7. Which of the following is best method for determining stability and transient response?

(a) Bode plot (b) Root locus (c) Nyquist plot (d) Polar plot

8. Routh-hurwitz criterion gives

(a) The number of roots lying on the left half of the s-plane
(b) The number of roots lying on the right half of the s-plane
(c) The number of roots lying on unity
(d) None of the above

9. Which of the following is a state variable?

(a) Current in a resistor (b) Capacitor voltage
(c) Inductor voltage (d) Voltage across resistor

10. For the circuit shown in Fig-1, the state variables are:

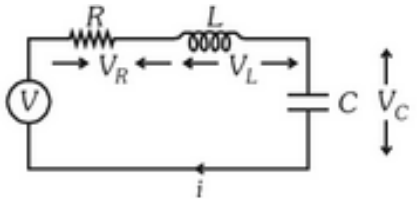

Figure 1

(a) i *and* V_R (b) V_L *and* V_R (c) V_L *and* V_C (d) i *and* V_C

PART - B (5 x 2 = 10 Marks)

11. Write the Mason's gain formula.

12. A unity feedback system has a open loop transfer function of $G(s) = \frac{10}{(s+1)(s+2)}$.

Determine the steady state error for unit step input.

13. Define. Gain margin.

14. What is the relation between stability and co-efficient of characteristic polynomial?

15. When a system is said to be controllable?

PART - C (5 x 16 = 80 Marks)

16. (a) Write the differential equations governing the mechanical rotational system shown in Figure 2. Also convert the elements of mechanical system into electrical analogous elements. (16)

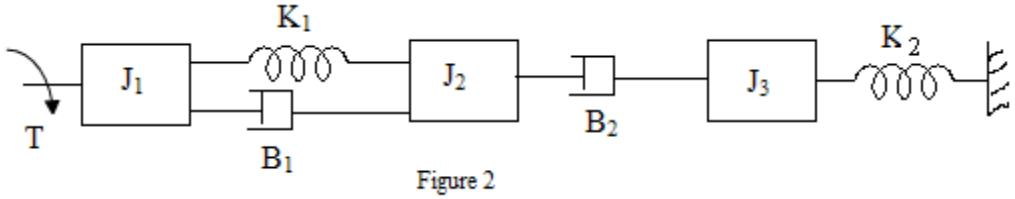

Figure 2

Or

(b) For the system represented by the block diagram shown in Figure 3, evaluate the closed loop transfer function when the input R is (i) at station-I ii) at station-II. (16)

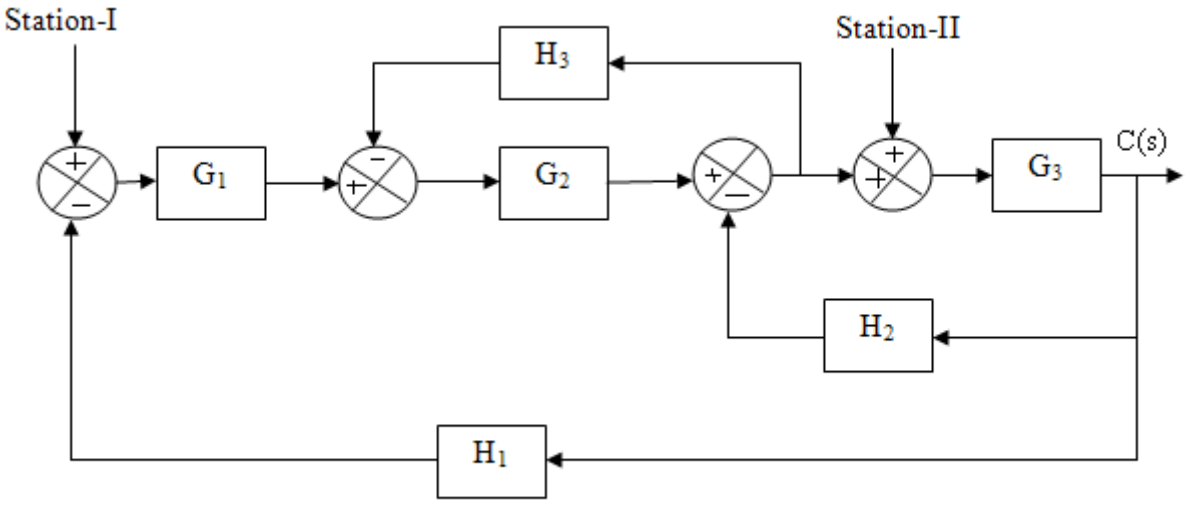

Figure 3

17. (a) The open loop transfer function of a servo system with unity feedback is $G(s) = \frac{10}{s(0.1s+1)}$. Evaluate the static error constants of the system. Obtain the steady state error of the system when it is subjected to an input represented as $r(t) = a_0 + a_1 t + \frac{a_2}{2} t^2$. (16)

Or

(b) Obtain the response of unity feedback system whose open loop transfer function is $G(s) = \frac{4}{s(s+5)}$. when the input is unit step. (16)

18. (a) Plot the Bode diagram for the following transfer function and obtain the gain and phase cross over frequencies.

$$G(s) = \frac{10}{s(1+0.4s)\,(1+0.1s)} \quad (16)$$

Or

(b) The open loop transfer function of a unity feedback system is given by $G(s) = \frac{4}{s(1+s)^2}$. Sketch the polar plot and determine the gain and phase margin. (16)

19. (a) Construct a Routh array and determine the stability of the system whose characteristic equation is .

$$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0.$$

Also determine the number of roots lying on right half of s-plane, left half of s-plane and on imaginary axis. (16)

Or

(b) A unity feedback control system has an open loop transfer function $G(s) = \frac{K}{s(s^2 + 4s + 13)}$. Sketch the root locus. (16)

20. (a) The state model of the system is given by

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 \\ -2 & -3 & 0 \\ 0 & 2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix} [u]; \quad y = [1\ 0\ 0] \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

Determine whether the system is completely controllable and observable. (16)

Or

(b) A discrete time system has the transfer function given as follows.

$\frac{Y(z)}{U(z)} = \frac{4z^3 - 12z^2 + 13z - 7}{(z-1)^2(z-2)}$. Determine the state model of the system in canonical form.

(16)